

WHAT IS CLAIMED IS:

1. A semiconductor device comprising:
  - a first electrode film;
  - a second electrode film opposing the first
  - 5 electrode film;
  - a capacitor insulating film provided between the first electrode film and the second electrode film;
  - a first connection part electrically connected to the first electrode film;
  - 10 a second connection part electrically connected to the second electrode film;
  - a first wiring electrically connected to the first electrode film by the first connection part;
  - a second wiring electrically connected to the
  - 15 second electrode film by the second connection part;
  - and
  - a protective insulating film provided between the capacitor insulating film and the second electrode film or on the second electrode film;
- 20 2. A semiconductor device according to claim 1, wherein the protective insulating film has relative dielectric constant  $\epsilon$  of at least 10.
3. A semiconductor device according to claim 1, wherein  $10 \leq \epsilon \leq 30$ , where  $\epsilon$  is relative dielectric
- 25 constant of the protective insulating film.
4. A semiconductor device according to claim 1, wherein  $10 \text{ nm} \leq X \leq 20 \text{ nm}$ , where X is a thickness of

the protective insulating film.

5        5. A semiconductor device according to claim 1,  
wherein the protective insulating film has a thickness  
X that ranges from 10% to 40% of the thickness of the  
capacitor insulating film.

6. A semiconductor device according to claim 1,  
wherein the capacitor insulating film is a tantalum  
oxide film.

10       7. A semiconductor device according to claim 1,  
wherein the protective insulating film is an aluminum  
oxide film.

8. A semiconductor device according to claim 1,  
further comprising a diffusion-preventing film provided  
below the first electrode film.

15       9. A semiconductor device according to claim 1,  
wherein the first wiring and the second wiring are  
formed of copper.

20       10. A semiconductor device according to claim 1,  
wherein the first connection part and the second  
connection part are formed of copper or tungsten.

25       11. A method of manufacturing a semiconductor  
device comprising a capacitor which has a first  
electrode film, a second electrode film, and a  
capacitor insulating film provided between the first  
and second electrode films, said method comprising:

forming a protective insulating film between the  
capacitor insulating film and the second electrode film

or on the second electrode film;

forming a insulating film on the capacitor;

forming a first trench configured to expose a part  
of the first electrode film, and a second trench

5 configured to expose a part of the second electrode  
film;

performing heat treatment which uses a hydrogen-  
containing gas; and

forming in the first trench a first connection  
10 part electrically connected to the first electrode, and  
forming in the second trench a second connection part  
electrically connected to the second electrode film.

12. A method according to claim 11, further  
comprising:

15 forming a first wiring trench and a second wiring  
trench before the heat treatment is performed, said  
first and second wiring trenches continuing with the  
first and second trenches, respectively; and

forming a first wiring and a second wiring in the  
20 first and second wiring trenches, respectively, at the  
same time the first and second connection parts are  
formed.

13. A method according to claim 11, wherein, the  
protective insulating film has relative dielectric  
25 constant  $\epsilon$  of at least 10.

14. A method according to claim 11, wherein  
 $10 \leq \epsilon \leq 30$ , where  $\epsilon$  is relative dielectric constant of

the protective insulating film.

15. A method according to claim 11, wherein  
10 nm  $\leq$  X  $\leq$  20 nm, where X is a thickness of the  
protective insulating film.

5        16. A method according to claim 11, wherein the  
protective insulating film has a thickness X that  
ranges from 10% to 40% of the thickness of the  
capacitor insulating film.

10       17. A method according to claim 11, wherein the  
capacitor insulating film is a tantalum oxide film.

18. A method according to claim 11, wherein the  
protective insulating film is an aluminum oxide film.

19. A method according to claim 11, wherein the  
capacitor is formed on a diffusion-preventing film.

15       20. A semiconductor device according to claim 12,  
wherein the first wiring and the second wiring are  
formed of copper.

20       21. A method according to claim 11, wherein the  
first connection part and the second connection part  
are formed of copper or tungsten.